CLAIMS

1. An apparatus comprising:

a film bulk acoustic resonator (FBAR) comprising a piezoelectric membrane having a portion thereof sandwiched between a first electrode and a second electrode, the piezoelectric membrane being suspended from at least two edges thereof; and

a heat transfer layer placed on the piezoelectric membrane surrounding, but not in contact with, the first electrode.

2. The apparatus of claim 1 wherein the heat transfer layer has a high thermal conductivity relative to the piezoelectric membrane.

3. The apparatus of claim 1 wherein the heat transfer layer extends from near the first electrode to the edges of the piezoelectric membrane.

4. The apparatus of claim 1 wherein the piezoelectric membrane is suspended from its edges by a pair of supports, the supports having a high thermal conductivity relative to the piezoelectric membrane.

5. The apparatus of claim 4 wherein the supports are silicon.

6. The apparatus of claim 1 wherein the piezoelectric material comprises aluminum nitride (AlN) or zinc oxide (ZnO).

7. The apparatus of claim 1 wherein the heat transfer layer comprises a metal.

8. The apparatus of claim 7 wherein the metal comprises gold (Au) or aluminum (Al).

9. An apparatus comprising:

a plurality of coupled film bulk acoustic resonators (FBARs) on a piezoelectric membrane, each FBAR comprising a portion of the

piezoelectric membrane sandwiched between a first electrode and a second electrode;

a heat transfer layer placed on the piezoelectric membrane surrounding, but not in contact with, the plurality of first electrodes.

10. The apparatus of claim 9 wherein the heat transfer layer has a high thermal conductivity relative to the piezoelectric membrane.

11. The apparatus of claim 9 wherein the heat transfer layer extends from near the plurality of first electrodes to the edges of the piezoelectric membrane.

12. The apparatus of claim 9 wherein the piezoelectric membrane is suspended from its edges by a pair of supports, the supports having a high thermal conductivity relative to the piezoelectric membrane.

13. The apparatus of claim 12 wherein the supports are silicon.

14. The apparatus of claim 9 wherein the piezoelectric material comprises aluminum nitride (AlN) or zinc oxide (ZnO).

15. The apparatus of claim 9 wherein the heat transfer layer comprises a metal.

16. The apparatus of claim 15 wherein the metal comprises gold (Au) or aluminum (Al).

17. A system comprising:

a signal source;

an FBAR coupled to the signal source, the FBAR comprising

a piezoelectric membrane having a portion thereof sandwiched between a first electrode and a second electrode, the piezoelectric membrane being suspended from at least two edges thereof, and

a heat transfer layer placed on the piezoelectric membrane surrounding, but not in contact with, the first electrode; and

a receiver to receive a signal generated by the signal source and passed through the FBAR.

18. The system of claim 17 wherein the heat transfer layer has a high thermal conductivity relative to the piezoelectric membrane.

19. The system of claim 17 wherein the heat transfer layer extends from near the first electrode to the edges of the piezoelectric membrane.

20. The system of claim 17 wherein the piezoelectric membrane is suspended from its edges by a pair of supports, the supports having a high thermal conductivity relative to the piezoelectric membrane.

21. The system of claim 20 wherein the supports are silicon.

22. The system of claim 17 wherein the piezoelectric material comprises aluminum nitride (AlN) or zinc oxide (ZnO).

23. The system of claim 17 wherein the heat transfer layer comprises a metal.

24. The system of claim 23 wherein the metal comprises gold (Au) or aluminum (Al).

25. A process comprising:

sandwiching a portion of the piezoelectric membrane between a first electrode and a second electrode;

suspending a piezoelectric membrane from at least two edges thereof; and

placing a heat transfer layer on the piezoelectric membrane surrounding, but not in contact with, the first electrode.

26. The process of claim 25 wherein suspending the piezoelectric membrane comprises suspending the membrane over a substrate between at least two supports connected to the substrate.

27. The process of claim 25 wherein placing the heat transfer layer on the piezoelectric membrane comprises screen printing the heat transfer layer thereon.

28. The process of claim 25 wherein placing the heat transfer layer on the piezoelectric membrane comprises electroplating the heat transfer layer thereon.

29. The process of claim 25 wherein placing the heat transfer layer on the piezoelectric membrane comprises solder plating the heat transfer layer thereon.

30. The process of claim 25, further comprising attaching a plate to the heat transfer layer along the edges of the membrane, the cap covering the membrane.

31. The process of claim 25, further comprising attaching a second plate to a second side of the membrane along the edges thereof.